ART 34 AMDT
Amended 30/04/04

10/501377
DT15 Rec'd PCT/PTO 14 JUL 2004

Claims

1. An electric motor monitoring system comprising an antenna, a data sampling means and a data processing means characterised in that the antenna provides means for detecting a radio-frequency signal generated by arcing events from a brush contact of the electric motor, and provides a diagnostic for monitoring the operation of both mechanical and electrical components of the electric motor.

2. An electric motor monitoring system as claimed in Claim 1 wherein the antenna comprises a means for screening background noise so improving the overall signal to noise ratio of the electric motor monitoring system.

3. An electric motor monitoring system as claimed in Claim 1 or Claim 2 wherein the antenna further comprises a frequency matching unit such that the frequency matching unit allows the antenna to be frequency tuned so as to optimise its operation with the electric motor.

4. An electric motor monitoring system as claimed in Claim 4 wherein the frequency matching unit comprises a signal conditioning unit.

5. An electric motor monitoring system as claimed in any of the preceding Claims wherein the antenna comprises a balanced Faraday screened loop antenna.

6. An electric motor monitoring system as claimed in claim 1 to 4 wherein the antenna comprises an unbalanced Faraday screened loop antenna.

7. An electric motor monitoring system as claimed in any of the preceding Claims wherein the antenna comprises an electric field probe or a magnetic field probe.

8. An electric motor monitoring system as claimed in any of the preceding Claims wherein the data sampling means comprises an anti aliasing filter, an analogue to digital converter and a high speed PCI card such the data sampling means allows the high frequency signal, over a predetermined length of time, to be captured.

9. An electric motor monitoring system as claimed in Claim 8 wherein the data processing means further comprises a computer processor capable of manipulating and storing the captured data.

10. An antenna for measuring high frequency radio frequency signals associated with arcing events from a brush contact in an electric motor, the antenna comprising a loop and a loop screen, wherein the loop screen shields the loop from background noise thus improving the signal to noise ratio of the signal detected by the antenna.

11. An antenna as claimed in Claim 10 wherein the loop screen physically covers all but a small detection section of the loop.

12. An antenna as claimed in Claim 10 or Claim 11 wherein the antenna further comprises a frequency matching unit such that the frequency matching unit allows the antenna to be frequency tuned so as to optimise the antenna's operation with the electric motor.

13. An antenna as claimed in Claim 12 wherein the frequency matching unit comprises a signal conditioning unit.

14. An antenna as claimed in any of Claims 10 to 13 wherein the loop comprises a conductor and a screened coaxial cable such that the conductor is turned back on itself so as to form one or more turns while the end of the conductor cable is attached to the screen of the coaxial cable.

15. A diagnostic method for monitoring the operation of both mechanical and electrical components associated with an electric motor, the method comprising the steps of:

i) Detecting high frequency radio frequency signals associated with arcing events from a brush contact within the electric motor;

ii) Sampling the high frequency signal over a predetermined length of time;

iii) Processing the sampled data so as to provide information regarding the mechanical and electrical components of the electric motor.

16. A diagnostic method according to Claim 15 wherein the method provides a means for associating the frequency of the high frequency signal to individual components of the electric motor.

17. A diagnostic method according to Claim 15 or Claim 16 wherein the detection of the high frequency signals employs a non-intrusive antenna.

18. A diagnostic method according to any of Claims 15 to 17 wherein the sampling provides a means for monitoring frequency modulation and amplitude modulation within the high frequency signals.

19. A diagnostic method according to any of Claims 15 to 18 wherein the processing of the sampled data comprises the application of Fast Fourier Transformations so as to convert the sampled data to interpretable frequency spectra.

20. A diagnostic method according to any of Claims 15 to 18 wherein the processing of the sampled data comprises the application of Digital Signal Processing techniques to the sampled data so as to convert the sampled data to interpretable frequency spectra.

21. A diagnostic method according to Claim 20 wherein the Digital Signal Processing techniques comprise Wavelet Analysis.

ART 34 AMDT

Amended 30/04/04

22. A diagnostic method according to any of Claims 19 to 21 wherein the interpretable frequency spectra comprise frequency features that can be directly associated with particular diagnostics of the mechanical or electrical components of the electric motor.

23. A diagnostic method according to any of Claims 19 to 22 wherein the interpretable frequency spectra comprise frequency features that can be directly associated with particular mechanical or electrical faults of the electric motor.

24. A diagnostic method according to any of Claims 15 to 18 wherein the processing of the sampled data comprises calculating an average width of the high frequency signals, above a predetermined level, over a number of arcing events.

25. A diagnostic method according to any of Claims 15 to 18 wherein the processing of the sampled data comprises calculating an average height of the high frequency signals over a number of arcing events.

26. A diagnostic method according to any of Claims 15 to 18 wherein the processing of the sampled data comprises calculating an average ratio of the width and height of the high frequency signals over a number of arcing events.

27. A diagnostic method according to any of Claims 15 to 26 wherein the method comprises a step of self-calibration of the diagnostic method.

28. A diagnostic method according to Claim 27 wherein the self-calibration of the diagnostic method comprises a current measuring technique including the sub-steps of:

i) Measuring the torque on the electric motor by employing the non-intrusive antenna;

ii) Measuring directly the current in the electric motor so as to enable the torque on the electric motor to be calculated;

iii) Taking the difference between the two methods for obtaining the value of the torque on the electric motor so providing a compensation factor; and

iv) Adding the compensation factor to the non-intrusive antenna method for measuring the torque on the electric motor.